



U.S. Department of Energy  
Energy Efficiency and Renewable Energy

*biomass program*

# Catalytic Hydrothermal Gasification

**DOE OBP Thermochemical Platform  
Review Meeting**

**June 7-8, 2005**

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- **Project Background**
- **Technical Feasibility and Risks**
- **Competitive Advantage**
- **Project Overview**
- **History and Accomplishments**
- **Plan/Schedule**
- **Critical Issues and Show-stoppers**
- **Plans and Resources for Next Stage**
- **Summary**



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- Initial contact between ANTARES and Eastman staff in 2003.
  - Potential for added value conversion of biobased byproducts generated on-site – Carbon closure
  - Strategic fit with Eastman business gasification services unit
  - Build on progress in wet biomass gasification at PNNL



# Pathways and Milestones – C-level and Project Milestones

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Aq Residues

4.11.2

Perennial Grasses

Woody Crops

5.11.2

Pulp and Paper

6.3.3

Forest Products

## Validation of Gasification Performance

Project Milestones	Type	Performance Expectations	Due Date
Chemical Analysis of Biosludge	C	Complete characterization of biosludge including seasonal/operational variations	11/05
Analysis - Key constituents of concern	C	Identify feedstock constituents of greatest concern relative to catalyst life/pump wear.	9/05
Economic Analysis	C	Preliminary commercial scale project economic analysis – Input to first stage gate review	9/05



# Technical Feasibility and Risks

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- Technical Issues
  - Catalyst life (Feedstock contaminants)
  - Pumping system design (Feedstock Flowability)
  - Reactor design (Materials & Configuration)
  - Syngas consistency, composition and yield
- Economic Issues
  - Syngas production costs
  - Syngas yield
  - Post gasification processing costs



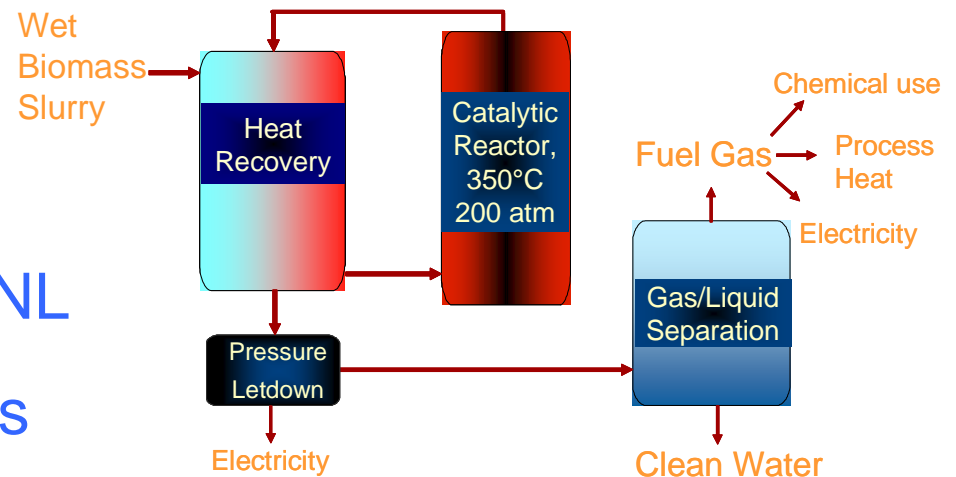
## *biomass program*

- Preparing for Commercial Launch
  - Resolve feedstock handling issues for Kingsport sludge
  - Resolve catalyst, pumping, and reactor issues
  - Test enabling technology at multiple scales
    - Batch
    - Continuous
    - Scaled-up on-site testing
  - Characterize “pilot-scale” system to sufficiently model economics
  - If results meet stage gate criteria - prepare pilot scale design for commercial demonstration at Kingsport site



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- CRADA executed (5/31/05).
- 4 months sludge samples undergoing analysis at PNNL
- Preliminary system analysis underway
- Preliminary economic analysis tool under construction
- Preliminary one-line process diagram under development





# History and Accomplishments

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- Project Plans through December '05
  - Initial characterization of sludge
    - Chemical and physical properties
    - Preliminary flowability properties
  - Preliminary process analysis
    - Pumping technology selection
      - Progressive cavity, double acting piston
    - Optimizing solids content
    - Reactor design
    - Heat exchange and other energy recovery
    - Catalyst protection
      - Sacrificial spent catalyst bed
      - Sulfur adsorbents





# History and Accomplishments

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- Project Plans through December '05
  - Economic analysis
    - Based on preliminary process diagram
    - Key items
      - Equipment capital costs
      - Catalyst (initial and regeneration/replacement costs)
      - System integration costs (commercial-scale)
      - Avoided dewatering/waste treatment costs
      - Incremental O&M (utilities, staffing, etc.)
      - Valuing on-site methane, heat, and electricity production



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- **Project Status**
  - CRADA negotiation delays led to accelerated schedule through fall 2005
  - Expect to meet all objectives scheduled through December 2005
  - First stage gate project review scheduled for
    - Technical and economic feasibility evaluation
    - Public and Private partner participation



# Critical Issues and Show-stoppers

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- Critical Performance Parameters
  - Verify conversion for Eastman Biosludges-target 99%
  - Achieve syngas energy content of >500 BTU/scf
  - Establish catalysts activity degradation of less than .5% after 300 hours operation
  - Verify gas composition potentially suitable for synthesis at Kingsport
  - Validate potential for syngas production cost less than \$4/MMBtu



# Critical Issues and Show-stoppers

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- Potential Show Stoppers
  - Rapid catalyst deactivation because of inability to capture sulfur or other poisons
  - Failure to reliably pump sludges to pressure
  - High volatility in system yields or gas quality
  - High cost



# Plans and Resources for Next Stage

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- Private partners are prepared to enter into commercial agreement once experimental phase concludes
  - Antares – biomass resources development
  - Eastman Chemical – process engineering and optimization
  - Galleon Engineering – materials handling
- Pilot Plant for Kingsport becomes the model facility and laboratory for perfecting the commercial system



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- Team plans to accelerate schedule during the next six months
- Sludge property data and initial reactor tests critical for first stage gate review
- Planning for an August '05 DOE review
  - Substantial technical data will be available
  - Preliminary economic results should be available